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PATENT ABSTRACTS OF JAPAN

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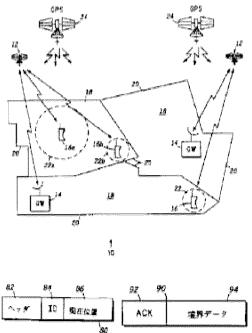
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(54) MOBILE UNIT TRACING SYSTEM

(57)Abstract:

PURPOSE: To provide a tracing system in which communicating amounts necessary for maintaining valid position data are minimized.

CONSTITUTION: A communication network 10 traces the position of a mobile unit 16 using it. The mobile unit decides the present position by using a signal transmitted from satellites 12 and 24 over the head by power-up, and then transmits a data communication message 80 indicating the position to the network. The network preserves the position, and returns a data message 90 indicating a boundary line 22 surrounding the position of the mobile unit. The mobile unit regularly and repeatedly judges the present position. Then, when the present position is outside the preliminarily



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normalized boundary line, another position data message 80 is transmitted to the network, the position data maintained by the network are updated, and the normalization of a new boundary line 22 is received.

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CLAIMS

[Claim(s)]

[Claim 1]Are a mobile unit the method of pursuing and this method, In a stage of receiving a data message (94) which shows a boundary line in said mobile unit (16), and said mobile unit (16), A stage (78) of judging a case where said mobile unit is in the outside of said boundary line, And a method of pursuing a mobile unit providing a stage (79) which transmits a current position data message (86) which shows a current position of said mobile unit (16) to said mobile unit (16) when said mobile unit is in the outside of said boundary line.

[Claim 2]Are a mobile unit (16) the method of pursuing, and this method, It is the stage of generating the original position data (74) in said mobile unit (16), In a stage (79) which transmits a data message which shows a position of said origin from that position data of said origin indicates the original position of said mobile unit to be, and said mobile unit, and said mobile unit, How to pursue a mobile unit (16) possessing a stage (88) of receiving a data message (94) which shows a boundary line.

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DETAILED DESCRIPTION

[Detailed Description of the Invention] [0001]

[Industrial Application] This invention generally relates to a tracking system (tracking systems). This invention relates to the tracking system which maintains the data in which the position of a mobile unit is shown more at details.

[0002]

[Description of the Prior Art]A tracking system uses radio, in order to discover the whereabouts of a mobile unit occasionally. One example of such a tracking system is used by the communication network which provides communications service with a mobile radio transmitter-receiver. The radio message which is not visible to a walkie-talkie user (transparent) continues notifying the position of the move transmitter-receiver which has received communications service in the central controller with this network. [0003]Position data is extremely worthy for a communication network. A network enables it to draw communication with the most sufficient convenience through the node of this network getting to know the position of a mobile unit. It enables it to suit in a network the various rules and procedures which a network may be imposed with various political substance which operates in the territorial jurisdiction. For example, one territorial jurisdiction may permit network employment only in the frequency of the 1st group, and the territorial jurisdiction which adjoins on the other hand may permit network employment only within the frequency of the 2nd group. It may be applied to the communications service used with the mobile unit which operates in the territorial jurisdiction where different customs duties differ from a tax. [0004]

[Problem(s) to be Solved by the Invention] it is clear that position data's it is better as it becomes more exact. More exact data enables it to check more the time of a network crossing to the territorial jurisdiction of one territorial jurisdiction to others [mobile unit] to fitness.

However, the strong necessity of cost increasing generally in proportion to the accuracy of position data, keeping cost as low as possible, and keeping an income as high as possible exists. It is the quantity of the communication resource consumed when maintaining the important position data of the present [one] of cost especially. The resources which can be exploited since it is used by a communications service member and an income is generated decrease more, so that it will be carried out, if more resources are consumed when maintaining the present position data. A mobile unit often carries out battery operation, and communication of a superfluous quantity leads to excessive use of available battery electric power.

[0005]Therefore, it is the purpose of this invention to provide the improved tracking system, and it is an advantage.

[0006]It is other purposes of this invention to provide the tracking system which minimum-izes quantity of communication required in order to maintain effective data, and it is an advantage. [0007]It is the purpose of further others of this invention to provide a programmable tracking system so that the necessity for various position reports that a mobile unit is imposed by various fields which operate in it can be suited, and it is an advantage. [0008]

[Means for Solving the Problem and its Function] The above, other purposes, and an advantage of this invention are realized by a method of pursuing a mobile unit with one gestalt. In a mobile unit, this method requires reception of a data message which describes a boundary line. A mobile unit judges a time of next this mobile unit being in the outside of this boundary line. When this mobile unit is in the outside of a boundary line, this mobile unit transmits a current position message which describes a position of a mobile unit at that time. [0009] The above, other purposes, and an advantage of this invention are attained by a method of pursuing a mobile unit with other gestalten. It is required that the method should receive the original position data from a mobile unit. Data of a position of these origin describes the original position of this mobile unit. Data of the original position of these is saved and a data message is transmitted to this mobile unit. This data message describes a boundary line surrounding a position of said origin.

[0010]

[Example]Being able to acquire a more perfect understanding of this invention by referring to the following detailed explanation and Claim with Drawings, in Drawings, the same reference number shows the same item over each figure.

[0011] <u>Drawing 1</u> shows one of many of the different fields of the earth where the communication network 10 operates. In desirable working example, the network 10 contains the artificial satellite 12 which goes the orbit of the earth around. The satellite 12 may be moving about the earth, may be standing it still (that is, it is in a geostationary orbit), or may

contain some each. It thinks including such all the composition [term / which is used here / "an orbit is gone around" (orbit)] "goes an earth orbit around" (orbit the earth) again.

Communication can be drawn through the gateway 14 through the satellite 12. The gateway 14 is arranged as an institution fixed on the ground. The satellite 12 and the gateway 14 act as the node (node) for the network 10. the arbitrary terminals in which the gateway 14 was connected to the public exchange telecommunications network (PSTN), and communication was combined with PSTN by it through the network 10 -- or it enables it to lead from the arbitrary terminals combined with PSTN

[0012] The network 10 provides communications service to arbitrary numbers of mobile units 16. As the name shows, the mobile unit 16 is movable to one of specific positions from not a thing but a place for exclusive use in a place. The mobile unit 16 contains the device which can be easily conveyed barely with portable stock molding equipment. The mobile unit 16 establishes the neighboring satellite 12 and data communication link, and this satellite 12 relays the data communications to the neighboring gateway 14 next.

[0013]The mobile unit 16 operates in the arbitrary things of much different political or political territorial jurisdiction 18. The territorial jurisdiction 18 is surrounded by the political or political boundary line 20. Generally, the boundary line 20 has irregular shape. The network 10 gets to know when the mobile unit 16 went across the boundary line 20, and frequency assignment, fee collection, a tax, and other parameters need to enable it to set it up according to the suitable territorial jurisdiction 18 by it. It gets to know where even if the network 10 is compared again and is not so exact, the mobile unit 16 is, and a call needs to be made to draw by it the best through the satellite 12.

[0014]As shown the mobile unit 16 by the mobile unit 16a, when it is located in the territorial jurisdiction 18, it is not close to the boundary line 20. As a result, it is only that the network 10 needs the comparatively inaccurate data about the position of the mobile unit 16a. The mobile unit 16a may move a comparatively big distance, before it approaches the boundary line 20. This big distance is shown by the radius of the surrounding circle of the mobile unit 16a. This circle forms the boundary line 22a.

[0015]On the other hand, as the mobile unit 16 is shown by the mobile unit 16b, when it is near the boundary line 20, the network 10 needs the comparatively exact data about the position of the mobile unit 16b. The mobile unit 16b can go into other territorial jurisdiction 18 by moving a comparatively small distance so that it may be shown by the radius of the boundary line 22b. [0016]The mobile unit 16 determines the position of these selves selectively at least so that it may explain in detail by the following. In desirable working example of this invention, when the mobile unit 16 makes this decision, it uses the global positioning system 24 like Global Positioning System (GPS). The system 24 includes the group of the artificial satellite which turns around the orbit of the earth. The satellite of the system 24 may be the same as the

satellite 12, or may differ. This is not an indispensable thing although the satellite of the system 24 differs from the satellite 12 in typical working example. Traditional art is used in order that the mobile unit 16 may supervise and process the signal transmitted by the system 24 in order to determine the position of these very thing. Although it is on account of explanation and this invention is not limited, and operation of the system 24 is described to the GPS position arrangement system, the person skilled in the art will understand that other spotting systems can be used.

[0017]In a general expression, the tracking system of this invention uses the gateway 14 of the mobile unit 16 and the network 10. The satellite 12 operates as a node for relaying the data communications between the mobile unit 16 and the gateway 14. In order that each mobile unit 16 may determine the position of itself and may tell the network 10 about the position, in the nearby "local" gateway 14, it transmits data communications to the network 10. When the gateway 14 receives the position communication, it generates the data which specifies the boundary line 22, and returns these boundary layer data to the mobile unit 16. As long as it is operating within the boundary line 22 as which the mobile unit 16 was specified, it does not need to notify the whereabouts to the network 10. However, when the mobile unit 16 moves to the outside of the boundary line 22, it transmits new position communication to the network 10, and receives new boundary layer regulation according to it.

[0018] Therefore, the tracking system of this invention makes the minimum the number of communication messages required in order to maintain an effective value. As shown by the mobile unit 16a and the boundary line 22a, when the data which is not so exact is permitted, the low data of correctness is maintained by some position communication messages. More exact data is maintained by more position communication messages when more exact data is required, as drawing 1 is shown by the mobile unit 16b and the boundary line 22b. [0019]Drawing 2 shows the block diagram of the mobile unit 16. The mobile unit 16 contains the transmitter-receiver 26 which transmits a signal and is received in the format which is compatible with the satellite 12 and the network 10 (see drawing 1). These signals contain the data message which can be made to carry out the data communications of the mobile unit 16 with the neighboring satellite 12. The data communications of the mobile unit 16 can be carried out to other arbitrary nodes of the network 10 like the neighboring gateway 14 (see drawing 1) via this satellite 12 again. For example, the receiver 28 for spotting of the mobile unit 16 like a GPS receiver generates the data which receives the signal broadcast by the positioning system 24 (see drawing 1) and in which the current position of the mobile unit 16 is shown. Both the transmitter-receiver 26 and the receiver 28 are combined with the processor 30. The processor 30 is further combined with input/output (I/O) section 32, the timer 34, and the memory 36. The I/O section 32 is used in order to collect user inputs like operation of an electric power switch, and in order to collect the telephone numbers for setting up a call. The

processor 30 uses the timer 34, in order to maintain the present time. The memory 36 contains in the mobile unit 16 the data which performs the procedure of explaining below, when the processor 30 performs including the data which acts as a command to the processor 30. The memory 36 contains the variable, table, and database which are operated by operation of the mobile unit 16.

[0020]Drawing 3 shows the block diagram of the gateway 14. The gateway 14 contains the transmitter-receiver 38 which transmits a signal and is received in the format which is compatible with the satellite 12 (see drawing 1). these signals -- the gateway 14 -- the neighboring satellite 12 -- and arbitrary numbers of mobile units 16 and the data message which can be made to carry out data communications are included. The transmitter-receiver 38 is combined with the processor 40. The processor 40 is combined with the I/O section 42, the timer 44, the memory 46, and PSTN interface 48 again. The I/O section 42 receives an input from a keyboard and other input devices, and provides a display terminal, a printer, and other output units with data. The processor 40 uses the timer 44, in order to maintain the present time. The memory 46 contains the semiconductor for memorizing the data which makes the gateway 14 perform the procedure of explaining below, and the memory storage of magnetic and others, when it acts as a command to the processor 40 and the processor 40 performs. The memory 46 contains the variable, table, and database which are operated by operation of the gateway 14. The gateway 14 communicates with PSTN with the interface 48. [0021]Drawing 4 shows the flow chart of the power up procedure 50 performed with the mobile unit 16 according to this invention. Procedure 50 is performed always, when the mobile unit 16 is energized. The task 52 performs initialization in the mobile unit 16. The person skilled in the art will understand between initialization that many memory locations can set it as a predetermined value. As shown in drawing 5, the position table 54 is memory structure which the mobile unit 16 maintains in the memory 36 (see drawing 2). The table 54 contains the data element explained in detail by the back. If it returns to drawing 4, the task 52 will set at least one of these data elements to a predetermined value. As soon as the positioning procedure of explaining below with reference to drawing 6 evaluates the data element by which it was initialized, a value predetermined [this] is chosen so that it may determine that it is required to transmit a position communication message to the gateway 14. As a result, the mobile unit 16 makes a position communication message the task 52 transmit to the gateway 14 according to energization of the mobile unit 16.

[0022]The task 56 synchronizes the transmitter-receiver 26 after the task 52 for communication with the neighboring satellite 12. The mobile unit 16 can be engaged in data communications with the network 10 after the task 56. The mobile unit 16 is registered into the network 10 in the task 58. This registration is attained by suiting a certain intrinsic proof (authentication) procedure which transmits to the gateway 14 which has served identification data, and is

imposed by the network 10. The served gateway 14 is determined by the neighboring satellite 12 in the beginning in the process which is not in sight of the mobile unit 16 and the both sides of the gateway 14 which have given their service. The mobile unit 16 is ready to transmit a call or receive after registration. While standing by the user input which the mobile unit 16 enters and orders it a call or an outgoing call, it operates by the standby mode 60. When a call occurs from the standby mode 60, it can go into the call-processing mode 62, and can return from this mode. When power down of the mobile unit 16 is carried out, it goes into the power down mode 64. When it is energized, the mobile unit 16 leaves the power down mode 64, and repeats the power up procedure 50.

[0023] <u>Drawing 6</u> shows the flow chart of the positioning procedure 66. The mobile unit 16 carries out repeat execution of Procedure 66 to a regular schedule, while it is operating in either the standby mode 60 or the call-processing mode 62 (see <u>drawing 4</u>). In desirable working example, this regular schedule may change from 1 degree to several minutes or 1 degree per several hours every several seconds.

[0024]It is judged whether between Procedures 66, the mobile unit 16 can be used in order to use it when the inquiry task 68 is performed and the signal from the positioning system 24 (see drawing 1) determines the position. In the usual operation, the system 24 is available and is the desirable art for determining a position. Therefore, when the system 24 is available, the mobile unit 16 performs the task 70 using the spotting receiver 28 (see drawing 2), and receives the signal from the system 24. The task 70 obtains 1 set of parameters which process the signal with a traditional form and show a current position.

[0025]On the other hand, in order that the network 10 may prevent that it is thoroughly dependent on the system 24, this invention includes the backup technique for determining a current position. Therefore, when the system 24 cannot be used, a current position is determined from the signal which the task 72 is performed and is transmitted by the satellite 12 of the network 10. In desirable working example, the satellite 12 operates around those orbits in o'clock in about 25,000 km /about the earth. Therefore, the signal of these satellites receives the Doppler (Doppler) shift of most quantity, and this Doppler shift changes, when a satellite passes along overhead location. The satellite 12 transmits the position data of a cell. As a result, when combined with the position data of a cell, the task 72 supervises the range (range) and range rate (range rate) data, in order to obtain the Doppler sign (Doppler signature) corresponding to the position of the mobile unit 16. The backup technique whose intention it has in the task 72 may be a low speed, and may be lower than the spotting art of the task 70. [of accuracy] Nevertheless, such backup position data is more preferred than there is also no position data.

[0026]After the current position of the mobile unit 16 is determined in either of the task 70 or 72, the task 74 saves the present position data, and evaluates the current position about the

present boundary layer 22a-22b (see <u>drawing 1</u>) established to the mobile unit 16. When it returns to <u>drawing 5</u>, the position table 54 contains the data elements 76 and 77 used, respectively in order to memorize present position data and boundary layer data.

[0027]In order that the task 70 may determine a current position, when it is used, present position data shows latitude and longitude preferably. A term "latitude (latitude)" and "longitude (longitude)" are considered including other arbitrary standards or measuring technique which can identify a position as used here. In one working example of this invention, boundary layer data shows the minimum and maximum latitude and longitude. Therefore, it is convenient that the boundary line 22 is a quadrangle or a rectangle. It is judged whether the task 74 has a current position in the outside of the boundary line 22 in a current position as compared with the boundary line 22.

[0028]In another working example of this invention, boundary layer data shows the distance interpreted as a radius (radius). The data element 79 of the position table 54 (see <u>drawing 5</u>) shows the original latitude and longitude of the position. It is investigated whether the task 74 is in a big distance from the original position rather than some compare that current position and the mobile unit 16 is indicated to be with this radius. In this working example, the boundary line 22 forms the circle which has a radius which has a center in the original position and is specified with boundary layer data, as shown in <u>drawing 1</u>. It is judged whether the task 74 has the mobile unit 16 in the outside of the boundary line 22 again. Boundary layer data is not limited to what shows a quadrangle, a rectangle, or a circle, but the person skilled in the art will understand that the arbitrary shape containing the shape of the political territorial jurisdiction 18 can be shown.

[0029]After the task 74, if the inquiry task 78 has a current position of the mobile unit 16 in the outside of the boundary line 22, it will lead programmed control to the task 79. The task 79 transmits the data message 80 of a current position to the network 10. <u>Drawing 7</u> shows the block diagram of the desirable format for the message 80. Especially the message 80 to the header 82 for notifying the network 10 that it is a current position message, and the network 10. The present position data 86 in which ID84 for reporting which mobile unit 16 has transmitted the message and the current position of the mobile unit 16 are shown by latitude/longitude or other parameter forms is included.

[0030]If it returns to <u>drawing 6</u>, Procedure 66 will stand by until the task 88 receives the response message 90 from the network 10 after the task 79. <u>Drawing 8</u> shows the block diagram of the desirable format for the message 90. Especially the message 90 includes the acknowledgement block 92 which reports that the network 10 received the front current position message 80 (see <u>drawing 7</u>) in the mobile unit 16. The message 90 contains the boundary layer data 94 in which the boundary line 22 (see <u>drawing 1</u>) is shown. The boundary layer data 94 should be constituted so that the boundary line 22 acquired as a result may

surround the current position pinpointed with the present position data 86 (see <u>drawing 7</u>) of the message 80.

[0031]After the message 90 is received, the task 96 (see <u>drawing 6</u>) saves the boundary layer data 94 (see <u>drawing 8</u>) to the data element 77 (see <u>drawing 5</u>) of the position table 54. The task 96 updates the time stamp-data element 98 of the position table 94, displays the present time, and updates the original position data element 79 (see <u>drawing 5</u>) of the position table 54, and displays a current position. Programmed control leaves Procedure 66 after the task 96. Procedure 66 is repeated according to the schedule after that.

[0032]If it returns to the task 78, when there is no current position of the mobile unit 16 in the outside of the boundary line 22, a different processing result will arise. Especially the procedure 66 investigates other conditions which can carry out the trigger of the transmission of the current position message to the network 10. Generally, in the usual operation, other conditions of these are backup conditions which are not produced rash. Therefore, when dealing with a report of the position generated as a result of these conditions, it is [that very little communication resources are only consumed and].

[0033]In particular, in desirable working example, it asks and it is judged whether as the current position of the mobile unit 16 was shown by the data element 79 (see <u>drawing 5</u>), only a predetermined distance exceeded the **** task 100 from the original position. Preferably, this predetermined distance is set to the big value like [it does not exceed it], unless a certain problem is encountered when the mobile unit 16 specifies the boundary line 22. If this predetermined distance is exceeded, the tasks 79, 88, and 96 are performed, and the network 10 is updated, and the new regulation over the boundary line 22 is received.

[0034]If this predetermined distance is not exceeded, the task 102 judges whether as compared with the present time, the predetermined period passed the time stamp (see drawing 5) recorded on the data element 98. This period is set to a very big value like [in January] 1 time, and when the mobile unit 16 which is in a state of rest comparatively by that cause reports those positions to the network 10, it is made to have most quantity of a communication resource consumed preferably. If this predetermined period does not exceed, the task 104 makes it make it Procedure 66 leave programmed control. On the other hand, if this predetermined period has passed, the task 104 will lead programmed control to the tasks 79, 88, and 96, in order to update the network 10.

[0035]If it returns to the task 52 (see <u>drawing 4</u>), the initialization of the position table 54 (see <u>drawing 5</u>) can set the time stamp-data element 98 to the predetermined value showing the day of the far past. Therefore, Procedure 66 is performed after energization, first, the task 104 detects a big period, a current position message is transmitted to the network 10, the original position and time stamp will be updated, and new boundary layer data will be received from the network 10.

[0036]Although Procedure 66 is repeated to a desirable regular schedule, the mobile unit 16 can receive a current position command message from the network 10 at arbitrary time, as shown in the node 106. It is ordered a current position command message so that it may answer by transmitting the data which shows the position of opposite Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. to the mobile unit 16. If this command is received, whether or not Procedure 66 will be active, the tasks 79, 88, and 96 will be performed. As stated above, in the tasks 79, 88, and 96, the mobile unit 16 transmits a current position message, and expects boundary layer data according to it.

[0037]Although the gateway 14 performs the pursuit function for the network 10 desirably, this pursuit function can also be performed in other parts of the network 10. Each gateway 14 performs this function to the mobile unit 16 registered there. In desirable working example, although each mobile unit 16 has the home (home) gateway 14, it is movable into the field served by other arbitrary gateways 14. The gateway 14 and the home gate way 14 which have been served can communicate mutually if needed, in order to share the information about the member mobile unit 16 through the network 10 or PSTN mutually. Drawing 9 shows the flow chart of the procedure performed when maintaining position data by the served gateway 14 for those registered mobile units 16. If it sees from the gateway 14, the current position message 80 (see drawing 7) is receivable from the registered arbitrary mobile units 16 at arbitrary time, as shown in the node 108. When the message 80 is received, the task 110 obtains the present position data 86 (see drawing 7) from the message 80.

[0038]The task 112 saves the present position data 86 in the memory structure of the subscriber database 114 maintained in the memory 46 (see <u>drawing 3</u>). <u>Drawing 10</u> shows the block diagram of the database 114. The database 114 includes the record 116 over each registered mobile unit 16. The data field [as opposed to ID of a mobile unit in each record 116] 118, the data field 120 to the telephone number of a mobile unit, the data field 122 to the original position of a mobile unit, the data field 124 for the time stamp relevant to the position of said origin, And other data elements 126 are included. Other data elements 126 show a related home or the gateway under service, a fee collection command, a service level identifier, and other arbitrary data required for operation of the network 10.

[0039]When drawing 9 - drawing 10 are referred to, the data field 122 of the original position shows the position known at the last of the related mobile unit 16. It is the data field 122 that the present position data 86 is stored. In other words, now, the current position is used as an original position. The task 128 saves the present time to the time stamp-data field 124. [0040]Next, since boundary layer data is generated, the task 130 uses the position of the present/origin which just received from the mobile unit 16. In desirable working example, the task 130 generates this boundary layer data using the boundary layer database 132. Drawing 11 shows the block diagram of the memory structure of the boundary layer database 132

maintained in the memory 46 (see <u>drawing 3</u>). The boundary layer database 132 includes the record 134 which shows the section of the field which receives service by the gateway 14. Each section is characterized with the minimum latitude 136, the maximum latitude 138, the minimum longitude 140, and the maximum longitude 142. The database 132 includes many records 134 as it is required to express the field which receives service by the gateway 14. Although this field does not necessarily need to be so, it can be fitted to one or the territorial jurisdiction 18 (see <u>drawing 1</u>) beyond it. Each record 134 contains the boundary layer data 144. The boundary layer data 144 describes the boundary line 22 (see <u>drawing 1</u>) which should relate to the arbitrary mobile units 16 located in the section specified with related latitude and the longitude 136-142. As stated above, the boundary layer data 144 can express the distance which acts as a radius. Or the boundary layer data 144 can express latitude and longitude. In practice, latitude and the longitude 136-142 can be committed as the boundary layer data 144.

[0041]If drawing 9 and drawing 11 are referred to, the task 130 will perform table-look-up operation, in order to detect the record 134 shown with the position data just received from the mobile unit 16 in the database 132. In desirable working example, the task 130 only reads suitable boundary layer data from the data element 144 of the database 132. This boundary layer data is constituted so that the boundary line 22 surrounding the position shown with said position data may be specified. If said position data becomes the form of the Doppler parameter and the satellite parameter, for example, the task 130 will change such a parameter into latitude and longitude information, before performing a table look-up to the database 132. [0042]After the task 130 obtains boundary layer data, the task 146 returns the boundary layer data response message 90 (see drawing 8) to the mobile unit 16. The gateway 14 and the network 10 have ended processing of the current position message received in the node 108 after the task 146.

[0043]The gateway 14 can perform the maintenance procedure 148, in order to guarantee that the position of the origin of it is still closer to a current position as much as possible. As shown in the task 150, Procedure 148 is performed only at the traffic (off-peak) time which separated from the peak preferably. If the communications traffic in the network 10 which in other words passed the gateway 14 is close to the peak capacity, Procedure 148 will be postponed behind. Thus, it is lost that the communication produced from performing Procedure 148 takes the communication resource which a member may need.

[0044]In the task 152, the member registered now when it has position data of the origin which the time stamp 124 of the record 116 in the subscriber database 114 (see <u>drawing 10</u>) was searched, and became old is looked for. The task 152 can search one the time stamp 124 indicates predetermined age to be at least about current time of the records 116. If old record is found, the task 154 will transmit to the mobile unit 16 in which the current position command

was shown, and will wait for a response from this mobile unit 16. If a response is received, it performs, as the tasks 110,112,128,130 and 146 stated above, and the original position and the time stamp-data elements 122 and 124 will be updated, and new boundary layer data will be returned to the mobile unit 16. After performing the task 146, the maintenance procedure 148 is repeatable about other old member records 116. [0045]

[Effect of the Invention]In short, this invention provides above the tracking system which minimum-izes quantity of communication required in order to maintain effective position data. A mobile unit is dynamically programmed with boundary layer data, and this boundary layer data is separately adapted for the position of a mobile unit. Therefore, this invention can respond to the necessity for the various position reports imposed in it by various fields where the mobile unit can operate.

[0046]This invention was explained about desirable working example as mentioned above. However, the person skilled in the art will recognize that change and correction can be made in this desirable working example, without separating from the range of this invention. For example, although it is explained that desirable working example uses the GPS Satellite base positioning system for providing a position signal to the mobile unit 16, other positioning systems or methods can also be used. it is used here -- as -- a term "spotting (position location)" -- a satellite base -- be -- or a ground base -- be -- it thinks including other possible positioning means and methods to the person skilled in the art. LORAN is an example of the positioning system which already used the available ground as the base in many portions in the world. Other positioning means and methods are also known. Therefore, it is considered that it is contained within the limits of this invention by these clear to a person skilled in the art, other change, and correction.

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TECHNICAL FIELD

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PRIOR ART

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[0003]Position data is extremely worthy for a communication network. A network enables it to draw communication with the most sufficient convenience through the node of this network getting to know the position of a mobile unit. It enables it to suit in a network the various rules and procedures which a network may be imposed with various political substance which operates in the territorial jurisdiction. For example, one territorial jurisdiction may permit network employment only in the frequency of the 1st group, and the territorial jurisdiction which adjoins on the other hand may permit network employment only within the frequency of the 2nd group. It may be applied to the communications service used with the mobile unit which operates in the territorial jurisdiction where different customs duties differ from a tax.

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EFFECT OF THE INVENTION

[Effect of the Invention]In short, this invention provides above the tracking system which minimum-izes quantity of communication required in order to maintain effective position data. A mobile unit is dynamically programmed with boundary layer data, and this boundary layer data is separately adapted for the position of a mobile unit. Therefore, this invention can respond to the necessity for the various position reports imposed in it by various fields where the mobile unit can operate.

[0046]This invention was explained about desirable working example as mentioned above. However, the person skilled in the art will recognize that change and correction can be made in this desirable working example, without separating from the range of this invention. For example, although it is explained that desirable working example uses the GPS Satellite base positioning system for providing a position signal to the mobile unit 16, other positioning systems or methods can also be used. it is used here -- as -- a term "spotting (position location)" -- a satellite base -- be -- or a ground base -- be -- it thinks including other possible positioning means and methods to the person skilled in the art. LORAN is an example of the positioning system which already used the available ground as the base in many portions in the world. Other positioning means and methods are also known. Therefore, it is considered that it is contained within the limits of this invention by these clear to a person skilled in the art, other change, and correction.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]It is clear that position data's it is better as it becomes more exact. More exact data enables it to check more the time of a network crossing to the territorial jurisdiction of one territorial jurisdiction to others [mobile unit] to fitness. However, the strong necessity of cost increasing generally in proportion to the accuracy of position data, keeping cost as low as possible, and keeping an income as high as possible exists. It is the quantity of the communication resource consumed when maintaining the important position data of the present [one] of cost especially. The resources which can be exploited since it is used by a communications service member and an income is generated decrease more, so that it will be carried out, if more resources are consumed when maintaining the present position data. A mobile unit often carries out battery operation, and communication of a superfluous quantity leads to excessive use of available battery electric power.

[0005]Therefore, it is the purpose of this invention to provide the improved tracking system, and it is an advantage.

[0006]It is other purposes of this invention to provide the tracking system which minimum-izes quantity of communication required in order to maintain effective data, and it is an advantage. [0007]It is the purpose of further others of this invention to provide a programmable tracking system so that the necessity for various position reports that a mobile unit is imposed by various fields which operate in it can be suited, and it is an advantage.

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OPERATION

[Means for Solving the Problem and its Function] The above, other purposes, and an advantage of this invention are realized by a method of pursuing a mobile unit with one gestalt. In a mobile unit, this method requires reception of a data message which describes a boundary line. A mobile unit judges a time of next this mobile unit being in the outside of this boundary line. When this mobile unit is in the outside of a boundary line, this mobile unit transmits a current position message which describes a position of a mobile unit at that time.

[0009] The above, other purposes, and an advantage of this invention are attained by a method of pursuing a mobile unit with other gestalten. It is required that the method should receive the original position data from a mobile unit. Data of a position of these origin describes the original position of this mobile unit. Data of the original position of these is saved and a data message is transmitted to this mobile unit. This data message describes a boundary line surrounding a position of said origin.

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EXAMPLE

[Example]Being able to acquire a more perfect understanding of this invention by referring to the following detailed explanation and Claim with Drawings, in Drawings, the same reference number shows the same item over each figure.

[0011] Drawing 1 shows one of many of the different fields of the earth where the communication network 10 operates. In desirable working example, the network 10 contains the artificial satellite 12 which goes the orbit of the earth around. The satellite 12 may be moving about the earth, may be standing it still (that is, it is in a geostationary orbit), or may contain some each. It thinks including such all the composition [term / which is used here / "an orbit is gone around" (orbit)] "goes an earth orbit around" (orbit the earth) again.

Communication can be drawn through the gateway 14 through the satellite 12. The gateway 14 is arranged as an institution fixed on the ground. The satellite 12 and the gateway 14 act as the node (node) for the network 10. the arbitrary terminals in which the gateway 14 was connected to the public exchange telecommunications network (PSTN), and communication was combined with PSTN by it through the network 10 -- or it enables it to lead from the arbitrary terminals combined with PSTN

[0012]The network 10 provides communications service to arbitrary numbers of mobile units 16. As the name shows, the mobile unit 16 is movable to one of specific positions from not a thing but a place for exclusive use in a place. The mobile unit 16 contains the device which can be easily conveyed barely with portable stock molding equipment. The mobile unit 16 establishes the neighboring satellite 12 and data communication link, and this satellite 12 relays the data communications to the neighboring gateway 14 next.

[0013] The mobile unit 16 operates in the arbitrary things of much different political or political territorial jurisdiction 18. The territorial jurisdiction 18 is surrounded by the political or political boundary line 20. Generally, the boundary line 20 has irregular shape. The network 10 gets to know when the mobile unit 16 went across the boundary line 20, and frequency assignment,

fee collection, a tax, and other parameters need to enable it to set it up according to the suitable territorial jurisdiction 18 by it. It gets to know where even if the network 10 is compared again and is not so exact, the mobile unit 16 is, and a call needs to be made to draw by it the best through the satellite 12.

[0014]As shown the mobile unit 16 by the mobile unit 16a, when it is located in the territorial jurisdiction 18, it is not close to the boundary line 20. As a result, it is only that the network 10 needs the comparatively inaccurate data about the position of the mobile unit 16a. The mobile unit 16a may move a comparatively big distance, before it approaches the boundary line 20. This big distance is shown by the radius of the surrounding circle of the mobile unit 16a. This circle forms the boundary line 22a.

[0015]On the other hand, as the mobile unit 16 is shown by the mobile unit 16b, when it is near the boundary line 20, the network 10 needs the comparatively exact data about the position of the mobile unit 16b. The mobile unit 16b can go into other territorial jurisdiction 18 by moving a comparatively small distance so that it may be shown by the radius of the boundary line 22b. [0016] The mobile unit 16 determines the position of these selves selectively at least so that it may explain in detail by the following. In desirable working example of this invention, when the mobile unit 16 makes this decision, it uses the global positioning system 24 like Global Positioning System (GPS). The system 24 includes the group of the artificial satellite which turns around the orbit of the earth. The satellite of the system 24 may be the same as the satellite 12, or may differ. This is not an indispensable thing although the satellite of the system 24 differs from the satellite 12 in typical working example. Traditional art is used in order that the mobile unit 16 may supervise and process the signal transmitted by the system 24 in order to determine the position of these very thing. Although it is on account of explanation and this invention is not limited, and operation of the system 24 is described to the GPS position arrangement system, the person skilled in the art will understand that other spotting systems can be used.

[0017]In a general expression, the tracking system of this invention uses the gateway 14 of the mobile unit 16 and the network 10. The satellite 12 operates as a node for relaying the data communications between the mobile unit 16 and the gateway 14. In order that each mobile unit 16 may determine the position of itself and may tell the network 10 about the position, in the nearby "local" gateway 14, it transmits data communications to the network 10. When the gateway 14 receives the position communication, it generates the data which specifies the boundary line 22, and returns these boundary layer data to the mobile unit 16. As long as it is operating within the boundary line 22 as which the mobile unit 16 was specified, it does not need to notify the whereabouts to the network 10. However, when the mobile unit 16 moves to the outside of the boundary line 22, it transmits new position communication to the network 10, and receives new boundary layer regulation according to it.

[0018] Therefore, the tracking system of this invention makes the minimum the number of communication messages required in order to maintain an effective value. As shown by the mobile unit 16a and the boundary line 22a, when the data which is not so exact is permitted, the low data of correctness is maintained by some position communication messages. More exact data is maintained by more position communication messages when more exact data is required, as drawing 1 is shown by the mobile unit 16b and the boundary line 22b. [0019]Drawing 2 shows the block diagram of the mobile unit 16. The mobile unit 16 contains the transmitter-receiver 26 which transmits a signal and is received in the format which is compatible with the satellite 12 and the network 10 (see drawing 1). These signals contain the data message which can be made to carry out the data communications of the mobile unit 16 with the neighboring satellite 12. The data communications of the mobile unit 16 can be carried out to other arbitrary nodes of the network 10 like the neighboring gateway 14 (see drawing 1) via this satellite 12 again. For example, the receiver 28 for spotting of the mobile unit 16 like a GPS receiver generates the data which receives the signal broadcast by the positioning system 24 (see drawing 1) and in which the current position of the mobile unit 16 is shown. Both the transmitter-receiver 26 and the receiver 28 are combined with the processor 30. The processor 30 is further combined with input/output (I/O) section 32, the timer 34, and the memory 36. The I/O section 32 is used in order to collect user inputs like operation of an electric power switch, and in order to collect the telephone numbers for setting up a call. The processor 30 uses the timer 34, in order to maintain the present time. The memory 36 contains in the mobile unit 16 the data which performs the procedure of explaining below, when the processor 30 performs including the data which acts as a command to the processor 30. The memory 36 contains the variable, table, and database which are operated by operation of the mobile unit 16.

[0020]Drawing 3 shows the block diagram of the gateway 14. The gateway 14 contains the transmitter-receiver 38 which transmits a signal and is received in the format which is compatible with the satellite 12 (see drawing 1). these signals -- the gateway 14 -- the neighboring satellite 12 -- and arbitrary numbers of mobile units 16 and the data message which can be made to carry out data communications are included. The transmitter-receiver 38 is combined with the processor 40. The processor 40 is combined with the I/O section 42, the timer 44, the memory 46, and PSTN interface 48 again. The I/O section 42 receives an input from a keyboard and other input devices, and provides a display terminal, a printer, and other output units with data. The processor 40 uses the timer 44, in order to maintain the present time. The memory 46 contains the semiconductor for memorizing the data which makes the gateway 14 perform the procedure of explaining below, and the memory storage of magnetic and others, when it acts as a command to the processor 40 and the processor 40 performs. The memory 46 contains the variable, table, and database which are operated by operation of

the gateway 14. The gateway 14 communicates with PSTN with the interface 48.

[0021]Drawing 4 shows the flow chart of the power up procedure 50 performed with the mobile unit 16 according to this invention. Procedure 50 is performed always, when the mobile unit 16 is energized. The task 52 performs initialization in the mobile unit 16. The person skilled in the art will understand between initialization that many memory locations can set it as a predetermined value. As shown in drawing 5, the position table 54 is memory structure which the mobile unit 16 maintains in the memory 36 (see drawing 2). The table 54 contains the data element explained in detail by the back. If it returns to drawing 4, the task 52 will set at least one of these data elements to a predetermined value. As soon as the positioning procedure of explaining below with reference to drawing 6 evaluates the data element by which it was initialized, a value predetermined [this] is chosen so that it may determine that it is required to transmit a position communication message to the gateway 14. As a result, the mobile unit 16 makes a position communication message the task 52 transmit to the gateway 14 according to energization of the mobile unit 16.

[0022]The task 56 synchronizes the transmitter-receiver 26 after the task 52 for communication with the neighboring satellite 12. The mobile unit 16 can be engaged in data communications with the network 10 after the task 56. The mobile unit 16 is registered into the network 10 in the task 58. This registration is attained by suiting a certain intrinsic proof (authentication) procedure which transmits to the gateway 14 which has served identification data, and is imposed by the network 10. The served gateway 14 is determined by the neighboring satellite 12 in the beginning in the process which is not in sight of the mobile unit 16 and the both sides of the gateway 14 which have given their service. The mobile unit 16 is ready to transmit a call or receive after registration. While standing by the user input which the mobile unit 16 enters and orders it a call or an outgoing call, it operates by the standby mode 60. When a call occurs from the standby mode 60, it can go into the call-processing mode 62, and can return from this mode. When power down of the mobile unit 16 is carried out, it goes into the power down mode 64. When it is energized, the mobile unit 16 leaves the power down mode 64, and repeats the power up procedure 50.

[0023] <u>Drawing 6</u> shows the flow chart of the positioning procedure 66. The mobile unit 16 carries out repeat execution of Procedure 66 to a regular schedule, while it is operating in either the standby mode 60 or the call-processing mode 62 (see <u>drawing 4</u>). In desirable working example, this regular schedule may change from 1 degree to several minutes or 1 degree per several hours every several seconds.

[0024]It is judged whether between Procedures 66, the mobile unit 16 can be used in order to use it when the inquiry task 68 is performed and the signal from the positioning system 24 (see drawing 1) determines the position. In the usual operation, the system 24 is available and is the desirable art for determining a position. Therefore, when the system 24 is available, the

mobile unit 16 performs the task 70 using the spotting receiver 28 (see <u>drawing 2</u>), and receives the signal from the system 24. The task 70 obtains 1 set of parameters which process the signal with a traditional form and show a current position.

[0025]On the other hand, in order that the network 10 may prevent that it is thoroughly dependent on the system 24, this invention includes the backup technique for determining a current position. Therefore, when the system 24 cannot be used, a current position is determined from the signal which the task 72 is performed and is transmitted by the satellite 12 of the network 10. In desirable working example, the satellite 12 operates around those orbits in o'clock in about 25,000 km /about the earth. Therefore, the signal of these satellites receives the Doppler (Doppler) shift of most quantity, and this Doppler shift changes, when a satellite passes along overhead location. The satellite 12 transmits the position data of a cell. As a result, when combined with the position data of a cell, the task 72 supervises the range (range) and range rate (range rate) data, in order to obtain the Doppler sign (Doppler signature) corresponding to the position of the mobile unit 16. The backup technique whose intention it has in the task 72 may be a low speed, and may be lower than the spotting art of the task 70. [of accuracy] Nevertheless, such backup position data is more preferred than there is also no position data.

[0026]After the current position of the mobile unit 16 is determined in either of the task 70 or 72, the task 74 saves the present position data, and evaluates the current position about the present boundary layer 22a-22b (see <u>drawing 1</u>) established to the mobile unit 16. When it returns to <u>drawing 5</u>, the position table 54 contains the data elements 76 and 77 used, respectively in order to memorize present position data and boundary layer data.

[0027]In order that the task 70 may determine a current position, when it is used, present position data shows latitude and longitude preferably. A term "latitude (latitude)" and "longitude (longitude)" are considered including other arbitrary standards or measuring technique which can identify a position as used here. In one working example of this invention, boundary layer data shows the minimum and maximum latitude and longitude. Therefore, it is convenient that the boundary line 22 is a quadrangle or a rectangle. It is judged whether the task 74 has a current position in the outside of the boundary line 22 in a current position as compared with the boundary line 22.

[0028]In another working example of this invention, boundary layer data shows the distance interpreted as a radius (radius). The data element 79 of the position table 54 (see <u>drawing 5</u>) shows the original latitude and longitude of the position. It is investigated whether the task 74 is in a big distance from the original position rather than some compare that current position and the mobile unit 16 is indicated to be with this radius. In this working example, the boundary line 22 forms the circle which has a radius which has a center in the original position and is specified with boundary layer data, as shown in <u>drawing 1</u>. It is judged whether the task 74 has

the mobile unit 16 in the outside of the boundary line 22 again. Boundary layer data is not limited to what shows a quadrangle, a rectangle, or a circle, but the person skilled in the art will understand that the arbitrary shape containing the shape of the political territorial jurisdiction 18 can be shown.

[0029]After the task 74, if the inquiry task 78 has a current position of the mobile unit 16 in the outside of the boundary line 22, it will lead programmed control to the task 79. The task 79 transmits the data message 80 of a current position to the network 10. <u>Drawing 7</u> shows the block diagram of the desirable format for the message 80. Especially the message 80 to the header 82 for notifying the network 10 that it is a current position message, and the network 10. The present position data 86 in which ID84 for reporting which mobile unit 16 has transmitted the message and the current position of the mobile unit 16 are shown by latitude/longitude or other parameter forms is included.

[0030]If it returns to <u>drawing 6</u>, Procedure 66 will stand by until the task 88 receives the response message 90 from the network 10 after the task 79. <u>Drawing 8</u> shows the block diagram of the desirable format for the message 90. Especially the message 90 includes the acknowledgement block 92 which reports that the network 10 received the front current position message 80 (see <u>drawing 7</u>) in the mobile unit 16. The message 90 contains the boundary layer data 94 in which the boundary line 22 (see <u>drawing 1</u>) is shown. The boundary layer data 94 should be constituted so that the boundary line 22 acquired as a result may surround the current position pinpointed with the present position data 86 (see <u>drawing 7</u>) of the message 80.

[0031]After the message 90 is received, the task 96 (see <u>drawing 6</u>) saves the boundary layer data 94 (see <u>drawing 8</u>) to the data element 77 (see <u>drawing 5</u>) of the position table 54. The task 96 updates the time stamp-data element 98 of the position table 94, displays the present time, and updates the original position data element 79 (see <u>drawing 5</u>) of the position table 54, and displays a current position. Programmed control leaves Procedure 66 after the task 96. Procedure 66 is repeated according to the schedule after that.

[0032]If it returns to the task 78, when there is no current position of the mobile unit 16 in the outside of the boundary line 22, a different processing result will arise. Especially the procedure 66 investigates other conditions which can carry out the trigger of the transmission of the current position message to the network 10. Generally, in the usual operation, other conditions of these are backup conditions which are not produced rash. Therefore, when dealing with a report of the position generated as a result of these conditions, it is [that very little communication resources are only consumed and].

[0033]In particular, in desirable working example, it asks and it is judged whether as the current position of the mobile unit 16 was shown by the data element 79 (see <u>drawing 5</u>), only a predetermined distance exceeded the **** task 100 from the original position. Preferably, this

predetermined distance is set to the big value like [it does not exceed it], unless a certain problem is encountered when the mobile unit 16 specifies the boundary line 22. If this predetermined distance is exceeded, the tasks 79, 88, and 96 are performed, and the network 10 is updated, and the new regulation over the boundary line 22 is received.

[0034]If this predetermined distance is not exceeded, the task 102 judges whether as compared with the present time, the predetermined period passed the time stamp (see drawing 5) recorded on the data element 98. This period is set to a very big value like [in January] 1 time, and when the mobile unit 16 which is in a state of rest comparatively by that cause reports those positions to the network 10, it is made to have most quantity of a communication resource consumed preferably. If this predetermined period does not exceed, the task 104 makes it make it Procedure 66 leave programmed control. On the other hand, if this predetermined period has passed, the task 104 will lead programmed control to the tasks 79, 88, and 96, in order to update the network 10.

[0035]If it returns to the task 52 (see <u>drawing 4</u>), the initialization of the position table 54 (see <u>drawing 5</u>) can set the time stamp-data element 98 to the predetermined value showing the day of the far past. Therefore, Procedure 66 is performed after energization, first, the task 104 detects a big period, a current position message is transmitted to the network 10, the original position and time stamp will be updated, and new boundary layer data will be received from the network 10.

[0036]Although Procedure 66 is repeated to a desirable regular schedule, the mobile unit 16 can receive a current position command message from the network 10 at arbitrary time, as shown in the node 106. It is ordered a current position command message so that it may answer by transmitting the data which shows the position of opposite Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. to the mobile unit 16. If this command is received, whether or not Procedure 66 will be active, the tasks 79, 88, and 96 will be performed. As stated above, in the tasks 79, 88, and 96, the mobile unit 16 transmits a current position message, and expects boundary layer data according to it.

[0037]Although the gateway 14 performs the pursuit function for the network 10 desirably, this pursuit function can also be performed in other parts of the network 10. Each gateway 14 performs this function to the mobile unit 16 registered there. In desirable working example, although each mobile unit 16 has the home (home) gateway 14, it is movable into the field served by other arbitrary gateways 14. The gateway 14 and the home gate way 14 which have been served can communicate mutually if needed, in order to share the information about the member mobile unit 16 through the network 10 or PSTN mutually. <u>Drawing 9</u> shows the flow chart of the procedure performed when maintaining position data by the served gateway 14 for those registered mobile units 16. If it sees from the gateway 14, the current position message 80 (see <u>drawing 7</u>) is receivable from the registered arbitrary mobile units 16 at arbitrary time,

as shown in the node 108. When the message 80 is received, the task 110 obtains the present position data 86 (see <u>drawing 7</u>) from the message 80.

[0038]The task 112 saves the present position data 86 in the memory structure of the subscriber database 114 maintained in the memory 46 (see drawing 3). Drawing 10 shows the block diagram of the database 114. The database 114 includes the record 116 over each registered mobile unit 16. The data field [as opposed to ID of a mobile unit in each record 116] 118, the data field 120 to the telephone number of a mobile unit, the data field 122 to the original position of a mobile unit, the data field 124 for the time stamp relevant to the position of said origin, And other data elements 126 are included. Other data elements 126 show a related home or the gateway under service, a fee collection command, a service level identifier, and other arbitrary data required for operation of the network 10. [0039]When drawing 9 - drawing 10 are referred to, the data field 122 of the original position shows the position known at the last of the related mobile unit 16. It is the data field 122 that the present position data 86 is stored. In other words, now, the current position is used as an original position. The task 128 saves the present time to the time stamp-data field 124. [0040]Next, since boundary layer data is generated, the task 130 uses the position of the present/origin which just received from the mobile unit 16. In desirable working example, the task 130 generates this boundary layer data using the boundary layer database 132. Drawing 11 shows the block diagram of the memory structure of the boundary layer database 132 maintained in the memory 46 (see drawing 3). The boundary layer database 132 includes the record 134 which shows the section of the field which receives service by the gateway 14. Each section is characterized with the minimum latitude 136, the maximum latitude 138, the minimum longitude 140, and the maximum longitude 142. The database 132 includes many records 134 as it is required to express the field which receives service by the gateway 14. Although this field does not necessarily need to be so, it can be fitted to one or the territorial jurisdiction 18 (see drawing 1) beyond it. Each record 134 contains the boundary layer data 144. The boundary layer data 144 describes the boundary line 22 (see drawing 1) which should relate to the arbitrary mobile units 16 located in the section specified with related latitude and the longitude 136-142. As stated above, the boundary layer data 144 can express the distance which acts as a radius. Or the boundary layer data 144 can express latitude and longitude. In practice, latitude and the longitude 136-142 can be committed as the boundary layer data 144.

[0041]If <u>drawing 9</u> and <u>drawing 11</u> are referred to, the task 130 will perform table-look-up operation, in order to detect the record 134 shown with the position data just received from the mobile unit 16 in the database 132. In desirable working example, the task 130 only reads suitable boundary layer data from the data element 144 of the database 132. This boundary layer data is constituted so that the boundary line 22 surrounding the position shown with said

position data may be specified. If said position data becomes the form of the Doppler parameter and the satellite parameter, for example, the task 130 will change such a parameter into latitude and longitude information, before performing a table look-up to the database 132. [0042]After the task 130 obtains boundary layer data, the task 146 returns the boundary layer data response message 90 (see <u>drawing 8</u>) to the mobile unit 16. The gateway 14 and the network 10 have ended processing of the current position message received in the node 108 after the task 146.

[0043]The gateway 14 can perform the maintenance procedure 148, in order to guarantee that the position of the origin of it is still closer to a current position as much as possible. As shown in the task 150, Procedure 148 is performed only at the traffic (off-peak) time which separated from the peak preferably. If the communications traffic in the network 10 which in other words passed the gateway 14 is close to the peak capacity, Procedure 148 will be postponed behind. Thus, it is lost that the communication produced from performing Procedure 148 takes the communication resource which a member may need.

[0044]In the task 152, the member registered now when it has position data of the origin which the time stamp 124 of the record 116 in the subscriber database 114 (see <u>drawing 10</u>) was searched, and became old is looked for. The task 152 can search one the time stamp 124 indicates predetermined age to be at least about current time of the records 116. If old record is found, the task 154 will transmit to the mobile unit 16 in which the current position command was shown, and will wait for a response from this mobile unit 16. If a response is received, it performs, as the tasks 110,112,128,130 and 146 stated above, and the original position and the time stamp-data elements 122 and 124 will be updated, and new boundary layer data will be returned to the mobile unit 16. After performing the task 146, the maintenance procedure 148 is repeatable about other old member records 116.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is an explanatory view showing in it the field of the earth where the communication network operates.

[Drawing 2]It is a block diagram showing the mobile unit which communicates with said network.

[Drawing 3]It is a block diagram showing the gateway which acts as a node in said network.

[Drawing 4] It is a flow chart which shows the power up procedure performed with said mobile unit.

[Drawing 5]It is a block diagram showing the position table memory structure maintained in said mobile unit.

[Drawing 6] It is a flow chart which shows the positioning procedure performed with said mobile unit.

[Drawing 7] It is a block diagram showing the current position data message transmitted with said mobile unit.

[Drawing 8] It is a block diagram showing the boundary layer data message transmitted by said gateway.

[Drawing 9]It is a flow chart which shows the procedure performed by said gateway.

[Drawing 10] It is a block diagram showing the member data base memory structure maintained in said gateway.

[Drawing 11] It is a block diagram showing the boundary layer data base memory structure maintained in said gateway.

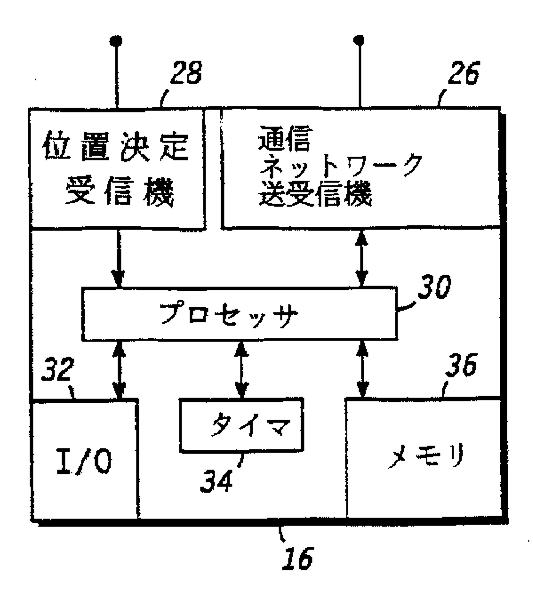
[Description of Notations]

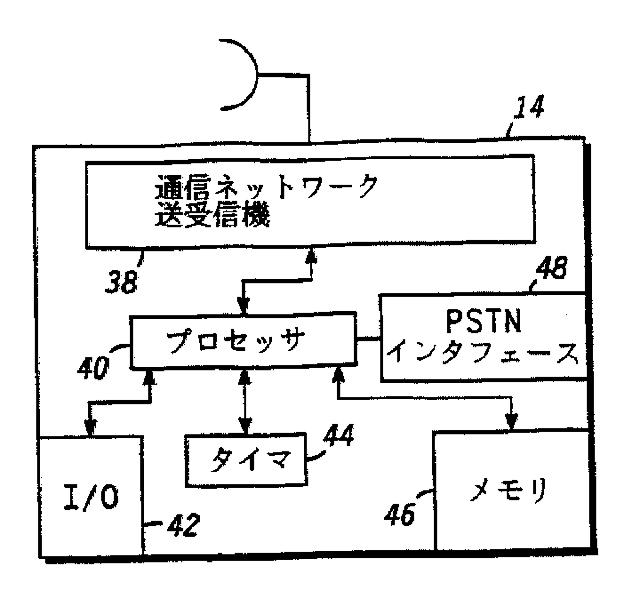
10 Communication network

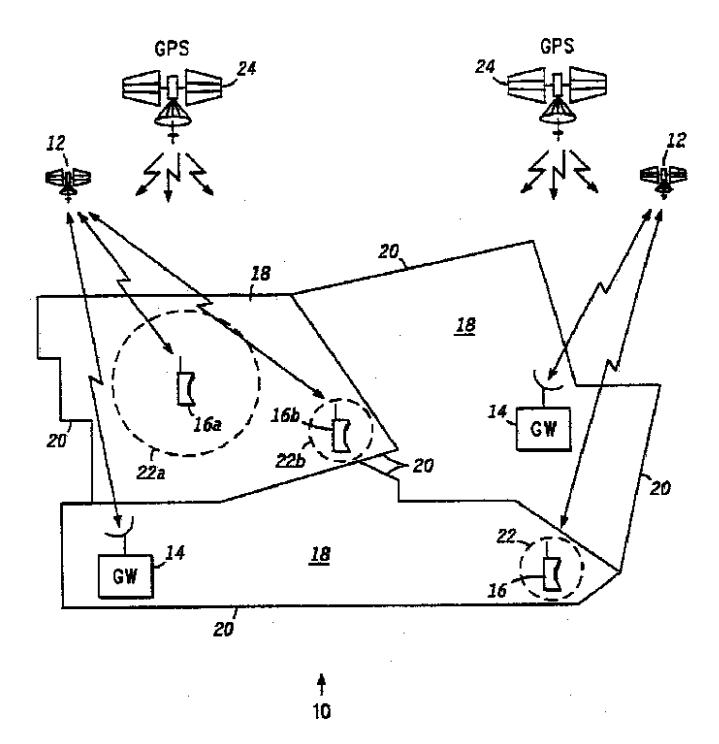
12 Artificial satellite

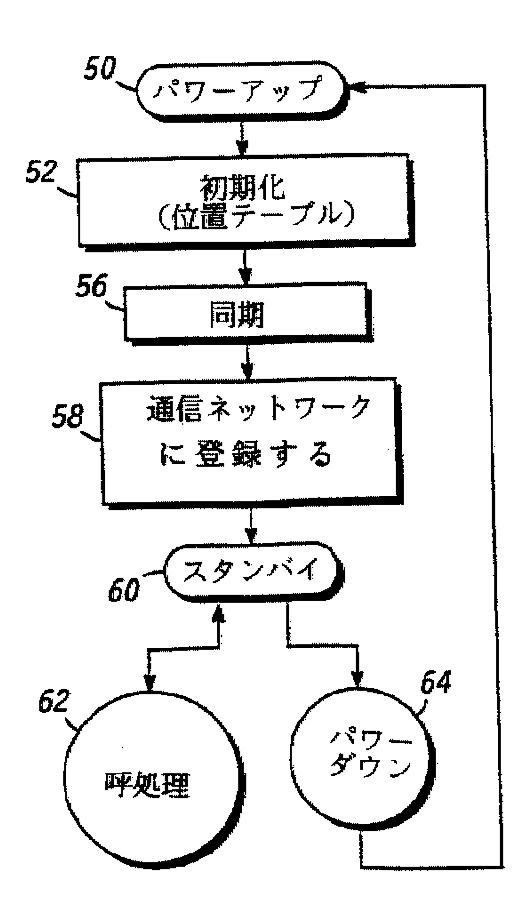
14 Gateway

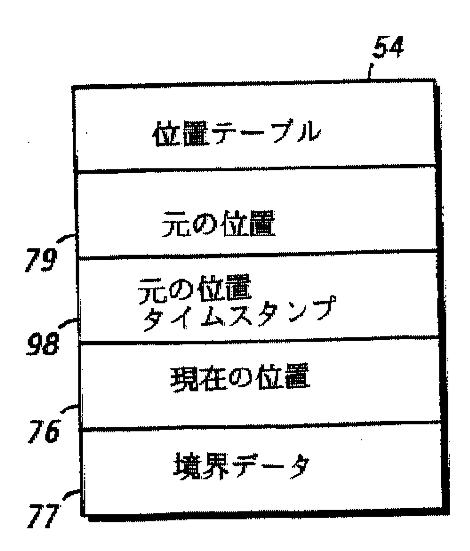
- 16 Mobile unit
- 18 Political territorial jurisdiction
- 20 and 22 Boundary line
- 24 Global positioning system
- 26 Transmitter-receiver
- 28 Receiver
- 30 Processor
- 32 and 42 Input/output (I/O) section
- 34 and 44 Timer
- 36 and 46 Memory
- 38 Transmitter-receiver
- 40 Processor
- 48 PSTN interface

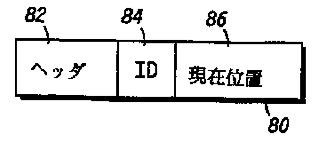








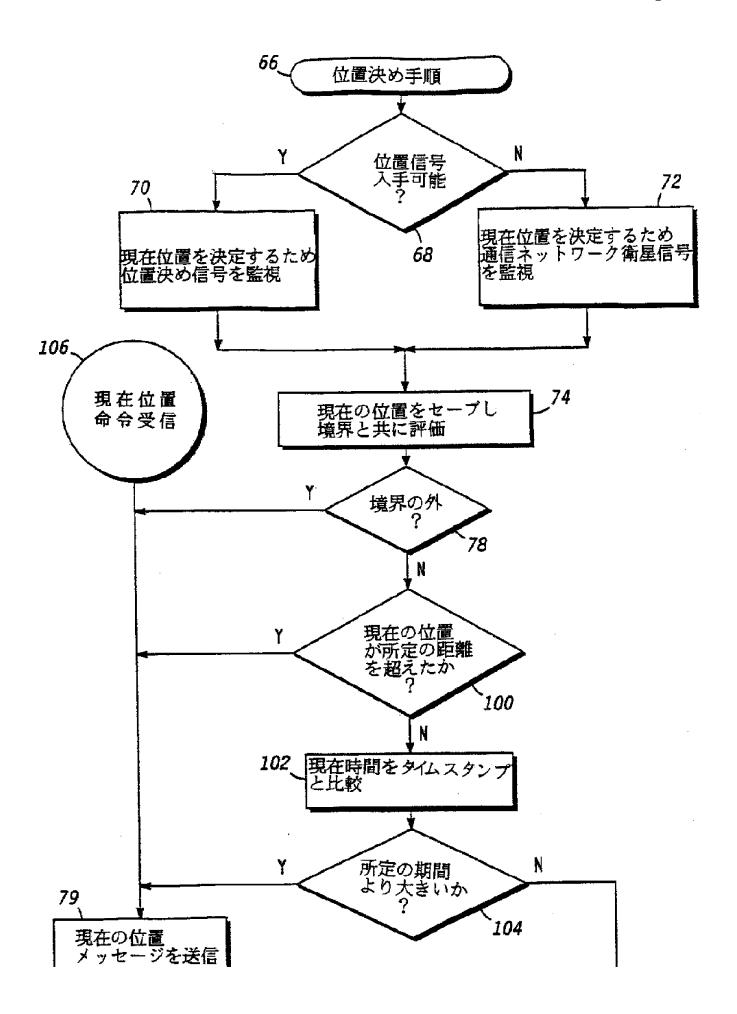


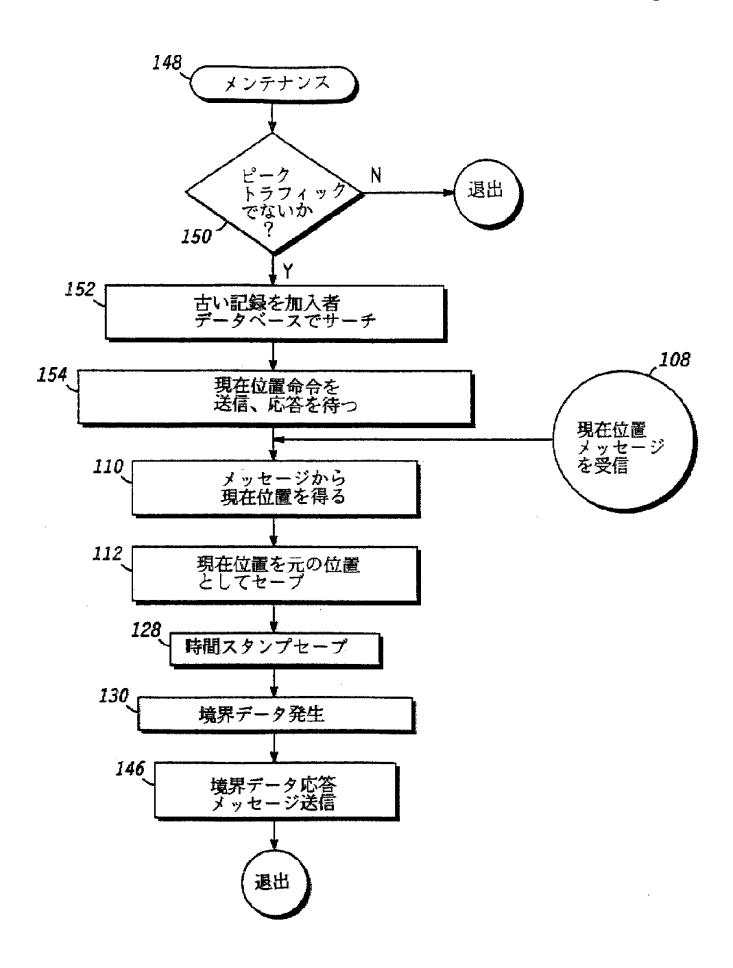




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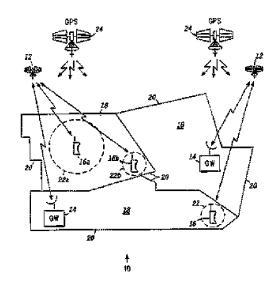
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(54)【発明の名称】 移動ユニット追跡システム

(57)【要約】

【目的】 有効な位置データを維持するために必要な通信量を最少化した追跡システムを提供する。

【構成】 通信ネットワーク(10)はそれを利用する移動ユニット(16)の位置を追跡する。パワーアップにより、移動ユニットは例えば頭上の衛星(12、24)により送信される信号を用いてそれらの現在位置を決定する。次に該位置を示すデータ通信メッセージ(80)をネットワークに送信する。ネットワークは該位置(122)を保存しかつ該移動ユニットの位置を囲む境界線(22)を示すデータメッセージ(90)を返送する。移動ユニットは規則的に現在位置を繰り返し判定する。現在位置が予め規定された境界線の外にあれば、他の位置データメッセージ(80)をネットワークに送信してネットワークによって維持される位置データを更新しかつ新しい境界線(22)の規定を受信する。



(2)

特関平5-327605

【特許請求の範囲】

【讀求項1】 移動ユニットを追跡する方法であって、 該方法は、

前記移動ユニット(16)において、境界線を示すデー タメッセージ(94)を受信する段階。

前記移動ユニット(16)において、前記移動ユニット が前記境界線の外側にある場合を判定する段階(7

8)、そして前記移動ユニットが前記境界線の外側にあ る場合に、前記移動ユニット(16)から前記移動ユニ ット(16)の現在位置を示す現在位置データメッセー 10 制御ユニットメモリ(46)、そして前記制御ユニット ジ(86)を送信する段階(79)。

を具備することを特徴とする移動ユニットを追跡する方

【請求項2】 移動ユニット(16)を追跡する方法で あって、該方法は、

前記移動ユニット(16)において、元の位置データ (24)を発生する段階であって、前記元の位置データ は前記移動ユニットの元の位置を示すもの、

前記移動ユニットから、前記元の位置を示すデータメッ 上において、境界線を示すデータメッセージ(94)を 受信する段階(88)、

を具備することを特徴とする移動ユニット(16)を追 跡する方法。

【請求項3】 移動ユニット(16)を追跡する方法で あって、該方法は、

前記移動ユニット(16)から元の位置データを受信す る段階(110)であって、前記元の位置データ(7) 9) は前記移動ユニット(16) の元の位置を示すも \mathcal{O}

前記元の位置データを保存する段階(112)」そして データメッセージを前記移動ユニット(16)に送信す る段階(146)であって、前記データメッセージは前 記元の位置を囲む境界線を示すもの。

を具備することを特徴とする移動ユニット(16)を追 跡する弁法。

【謔求項4】 移動ユニットに対する位置を示すデータ を管理するシステムにおいて使用するための該移動ユニ ット(16)であって、前記システムが、

位置発生器(2.8)。

ヌモリ(36)

送受信機(26)、そして前記位置発生器、前記メモ リ、および前記送受信機に結合され、前記位置発生器か ら元の位置データを得、前記メモリに前記元の位置デー タを保存させ、かつ前記送受信機に前記元の位置データ を送信させるよう構成されているプロセッサ(30)、 を具備することを特徴とする移動ユニット(16)。

【請求項5】 副御ユニット(14)と移動ユニット (16)との間で通信される追跡データを追跡データ通 て、該システムは、

移動ユニット位置発生器(28)、

移動ユニットメモリ(36)、

移動ユニット送受信機(26)、

前記位置発生器、前記移動ユニットメモリ、および前記 移動ユニット送受信機に結合された移動ユニットプロセ ッサ(30)。

前記移動ユニット送受信機(26)とデータ通信する制 御ユニット送受信機(38)、

送受信機(38)および前記制御ユニットメモリ(4 6)に結合された制御ユニットプロセッサ(40)、 を具備することを特徴とする制御ユニット(14)と移 動ユニット(16)との間で通信される追跡データを管 理するためのシステム。

【発明の詳細な説明】

[0001]

【産業上の利用分野】本発明は一般的には追跡システム (tracking systems)に関する。より セージを送信する段階(79)、そして前記移動ユニッ 20 詳細には、本発明は移動ユニットの位置を示すデータを 維持する追跡システムに関する。

[0002]

【従来の技術】追跡システムは時折移動ユニットの所在 を発見するために無線通信を使用する。そのような追跡 システムの1つの例は移動無線送受信機によって通信が ービスを提供する通信ネットワークによって使用され る。無線機ユーザに見えない(transparen 無線通信メッセージは中央コントローラに該ネッ トワークによって通信サービスを受けている移動送受信 30 機の位置を運知し続ける。

【0003】位置データは通信ネットワークにとって極 めて価値があるものである。移動ユニットの位置を知る ことはネットワークが該ネットワークのノードを通して 最も都合よく通信を導くととができるようにする。さら に、それはネットワークがその管轄区内で動作する種々 の政治的な実体によって謙され得る種々の規則および手 順にネットワークが適合できるようにする。例えば、1 つの管轄区はネットワークの運用を第1の組の周波数内 にのみ許容し、一方隣接する管轄区はネットワークの運 40 用を第2の組の周波数内でのみ許容するかもしれない。 さらに、異なる関税または租税が異なる管轄区で動作す る移動ユニットによって使用される通信サービスに対し

[0004]

て適用されるかも知れない。

【発明が解決しようとする課題】位置データはより正確 になればなるほど良いことは明らかである。より正確な データはネットワークが移動ユニットが1つの管轄区か ち他の管轄区に渡った時をより良好に確認できるように する。しかしながら、位置データの正確さに比例して一 信が最少化されるように管理するためのシステムであっ 50 般にコストが増大し、かつコストをできるだけ低く保ち

かつ収入をできるだけ高く保つ強い必要性が存在する。 特に重要な、コストの1つは現在の位置データを維持す る上で消費される通信資源の置である。現在の位置デー タを維持する上でより多くの資源が消費されればされる ほど、通信サービス加入者によって使用しかつ収入を発 生するために利用できる資源がより少なくなる。さら に、移動ユニットはしばしばバッテリ動作し、かつ過剰 な量の通信は利用可能なバッテリ電力の余分な使用につ

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るのが本発明の目的でありかつ利点である。

【0006】有効なデータを維持するために必要な通信 の量を最少化する追跡システムを提供するのが本発明の 他の目的でありかつ利点である。

【0007】移動ユニットがその中で動作する種々の領 域によって課される種々の位置報告の必要性に適合する ことができるようにプログラム可能な追跡システムを提 供するのが本発明のさらに他の目的でありかつ利点であ る。

180001

【課題を解決するための手段および作用】本発明の上記 および他の目的および利点は1つの形態で移動ユニット を追跡する方法によって実現される。移動ユニットにお いて、本方法は境界線を記述するデータメッセージの受 信を要求する。移動ユニットは次に該移動ユニットが該 織界線の外側にある時を割定する。該移動ユニットが織 界線の外側にある時には、該移動ユニットはその時の移 動ユニットの位置を記述する現在位置メッセージを送信 する。

他の形態で移動ユニットを追動する方法によって達成さ れる。その方法は移動ユニットから元の位置データを受 信することを要求する。これら元の位置のデータは該移 動ユニットの元の位置を記述する。とれらの元の位置の データは保存され、かつデータメッセージが該移動ユニ ットに送信される。該データメッセージは前記元の位置 を囲む境界線を記述する。

[0010]

【実施例】本発明のより完全な理解は図面と共に以下の 詳細な説明および請求の範囲を参照することにより得る。40。の回りの円の半径によって示されている。この四が総界 ことができ、図面においては同じ参照数字は各図にわた。 り同じ項目を示している。

【①①11】図1は通信ネットワーク10が動作する地 球の数多くの異なる領域の1つを示す。好ましい実施例 においては、ネットワーク10は地球の軌道を周回する。 |大工衛星12を含む。衛星12は地球に関して移動して いても良く、あるいは静止していても良く(すなわち、 地球静止軌道にある)、あるいはそれぞれを殺らか含む ものでも良い。ことで用いられている、用語「軌道を周

すりit the earth)」はすべてのそのよう な構成を含むものと考えている。通信は衛星12を通り かつゲートウェイ!4を通って導くことができる。ゲー トウェイ14は地上に固定された施設として配置され る。衡星12およびゲートウェイ14はネットワーク1 ①のためのノード (node) として作用する。ゲート ウェイ14は公共交換電気通信ネットワーク(PST

N)に接続され、それによって通信がネットワーク10 を通ってPSTNに結合された任意の端子にあるいはP 【0005】従って、改良された追跡システムを提供す「10」STNに結合された任意の端子から導くことができるよ うにする。

> 【0012】ネットワーク10は任意の数の移動ユニッ ト16に対し通信サービスを提供する。その名前が示す ように、移動ユニット16はいずれかの特定の位置に専 用のものではなく、場所から場所へと移動できる。移動 ユニット16は容易に携帯可能な手持ち型装置と共にか ろうじて輸送できる装置を含む。移動ユニット16は近 瞬の衛星12とデータ通信リンクを確立し、該衛星12 は欠にそのデータ通信を近隣のゲートウェイ!4に中継 20 する。

【 0 0 1 3 】移動ユニット 1 6 は数多くの異なる政治的。 または政策的管轄区18の内の任意のものの中で動作す る。管轄区18は政治的または政策的境界線20によっ で囲まれている。一般に、境界線20は不規則な形状を 有する。ネットワーク10は移動ユニット16がいつ鏡 界線20を渡ったかを知り、それによって周波数割当。 て、課金、税金、および他のパラメータが適切な管轄区 18に従って設定できるようにする必要がある。ネット ワーク10はまた例えそれほど正確でなくても、移動ユ 【0009】本発明の上記および他の目的および利点は、30、ニット16がどこにあるかを知り、それによって呼が衝 星12を通して最も良好に導かれるようにする必要があ

> 【0014】移動ユニット16が、移動ユニット16a で示されるように、管轄区18内に位置する時、それは 纜界線20に近くはない。その結果、ネットワーク10 は移動ユニット16aの位置に関する比較的不正確なデ ータを必要とするのみである。移動ユニット16aはそ れが境界線20に近付く前に比較的大きな距離を移動す るかも知れない。この大きな距離は移動ユニット16a 線22aを形成する。

【0015】とれに対し、移動ユニット16が、移動ユ ニット16万で示されるように、境界線20の近くにあ る場合には、ネットワーク10は移動ユニット16もの 位置に関する比較的正確なデータを必要とする。移動ユ ニット16りは境界線220の半径によって示されるよ うに、比較的小さな距離を移動することにより他の管轄 区18に入るととができる。

【0016】以下により詳細に説明するように、移動ユ 回する(orbit)」また「地球軌道を周回する(o-50-ニット16は、少なくとも部分的に、それら自身の位置

(3)

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を決定する。本発明の好ましい実施例においては、移動 ユニット16は、この決定を行う上で、全地球側位シス テム(GPS)のような。衛星測位システム24を利用 する。システム24は地球の軌道を回る人工衛星の集団 を含む。システム24の衛星は衛星12と同じでもよく あるいは異なっても良い。典型的な実施例では、システ ム24の衛星は衛星12と異なるが、これは必須のこと ではない。移動ユニット16はそれら自体の位置を決定 するためにシステム24によって送信される信号を監視 しかつ処理するために伝統的な技術を利用する。説明の「19」36はプロセッサ30への命令として作用するデータを 都合上であって本発明を限定するものではないが、シス テム24の動作はGPS位置決めシステムに対して述べ られているが、当業者は他の位置決定システムも利用で きることを理解するであろう。

【①①17】一般的な表現では、本発明の追跡システム は移動ユニット16 およびネットワーク10のゲートウ ェイ14を使用する。衛星12は移動ユニット16とゲ ートウェイ14との間のデータ通信を中継するためのノ ードとして動作する。各移動ユニット16はそれ自身の るため近くの「ローカル」ゲートウェイ!4においてネ ットワーク10にデータ通信を送信する。ゲートウェイ 14がその位置通信を受信した時、それは境界線22を 規定するデータを発生してれらの機界線データを移動ユ ニット16に返送する。移動ユニット16が規定された 境界線22内で動作している限り、それはネットワーク 10にその所在を運知する必要はない。しかしながら、 移動ユニット16が境界線22の外側に移動した時、そ れは新しい位置通信をネットワーク10に送信しかつそ れに応じて新しい境界線規定を受信する。

【0018】従って、本発明の追跡システムは有効な値 を維持するために必要な通信メッセージの数を最小にす る。移動ユニット16aおよび境界線22aで示される ように、それほど正確でないデータが許容される場合に は、少しの位置通信メッセージによって正確さの低いデ ータが維持される。図1において移動ユニット16りお よび境界線220で示されるように、より正確なデータ が要求される場合にはより多くの位置通信メッセージに よってより正確なデータが維縛される。

示す。移動ユニット16は衛星12およびネットワーク 10(図1を参照)と両立するフォーマットで信号を送 信しかつ受信する送受信機26を含む。これらの信号は 移動ユニット16が近隣の衛星12とデータ通信できる ようにするデータメッセージを含む。この衛星12を介 して移動ユニット16はまた、近隣のゲートウェイ14 (図1を参照)のような、ネットワーク10の任意の他 のノードとデータ通信することができる。例えば、GP S受信機のような、移動ユニット16の位置決定用受信 畿28は側位システム24(図1を参照)によって放送 50 レメントを評価するや否や位置通信メッセージがゲート

される信号を受信しかつ移動ユニット16の現在位置を 示すデータを発生する。送受信機26および受信機28 は共にプロセッサ30に結合されている。プロセッサ3 ①はさらに入力/出力(1/O)セクション32、タイ マ34、およびメモリ36に結合されている。1/Oセ クション32は、電源スイッチの操作のような、ユーザ 入力を集めるため、および呼を設定するための電話番号。 の収集を行うために使用される。プロセッサ30は現在 の日時を維持するためにタイマ34を使用する。メモリ 含み、かつ、プロセッサ30により実行された時、移動 ユニット16に以下に説明する手順を実行させるデータ を含む。さらに、メモリ36は移動ユニット16の動作 によって操作される変数。テーブル、およびデータベー スを含む。

【0020】図3は、ゲートウェイ14のブロック図を 示す。ゲートウェイ14は衛星12(図1を参照)と両 立するフォーマットで信号を送信しかつ受信する送受信 機38を含む。これらの信号はゲートウェイ14が近隣 位置を決定しかつネットワーク10にその位置を知らせ、20 の衛星12とかつ任意の数の移動ユニット16とデータ 通信できるようにするデータメッセージを含む。送受信 機38はプロセッサ40に結合されている。プロセッサ 40はまた!/〇セクション42、タイマ44、メモリ 46、およびPSTNインタフェース48に結合されて いる。!/Oセクション42はキーボードおよび他の入 力装置から入力を受信しかつデータを表示ターミナル、 プリンタ、および他の出力装置に提供する。プロセッサ 4.0 は現在の日時を維持するためにタイマ4.4 を使用す る。メモリ46はプロセッサ40への命令として作用し 30 かつ、プロセッサ40によって実行された時、ゲートウ ェイト4に以下に説明する手順を実行させるデータを記 (確するための半導体、磁気的、および他の記憶装置を含 む。さらに、メモリ46はゲートウェイ14の動作によ って操作される変数、テーブル、およびデータベースを 念む。インタフェース48により、ゲートウェイ14は PSTNと通信する。

【0021】図4は本発明に従って移動ユニット16に よって行われるパワーアップ手順50のフローチャート を示す。手順50は移動ユニット16が付勢された時に 【0019】図2は、移動ユニット16のブロック図を「49」はいつでも実行される。タスク52は移動ユニット16 内の初期化を行う。当業者は初期化の間に数多くのメモ り位置が所定の値に設定できることを理解するである う。図5に示されるように、位置テーブル54は移動ユ ニット16がメモリ36(図2を参照)内に維持するメ モリ構造である。テーブル54は後により詳細に説明す るデータエレメントを含む。図4に戻ると、タスク52 はこれらのデータエレメントの内の少なくとも1つを所 定の値にセットする。該所定の値は、図6を参照して以 下に説明する。測位手順がそれが初期化されたデータエ (5)

ウェイ14に送信されることが必要であることを決定す るように選択される。その結果、タスク52は移動ユニ ット16が移動ユニット16の付勢に応じて位置通信メ ッセージをゲートウェイ14に送信するようにさせる。 【0022】タスク52の後、タスク56は送受信機2 6を近隣の衛星12との通信のために同期させる。タス ク5 6の後、移動ユニット16 はネットワーク10との データ通信に従事することができる。タスク58におい では、移動ユニット16はネットワーク10に登録す。 ェイ14に送信しかつネットワーク10によって課され る何らかの真性証明(authentication) 手順に適合することによって達成される。サービスして いるゲートウェイ14は始めは移動ユニット16および サービスしているゲートウェイ14の双方に見えないブ ロセスで近隣の衛星12によって決定される。登録の 後、移動ユニット16は呼を送信しあるいは受信する用 意ができる。移動ユニット16が入り呼または出呼を指 合するユーザ入力を待機している時は、それはスタンバ イモード60で動作する。スタンバイモード60から呼「20」 ータおよび幾界線データを記憶するために使用されるデ が発生した時それは呼処理モード62に入りかつ該モー 下から戻ることができる。移動ユニット16がパワーダ ウンされた時、それはパワーダウンモード64に入る。 移動ユニット16はそれが付勢された時パワーダウンモ ード64を退出してパワーアップ手順50を反復する。 【0023】図6は、測位手順66のプローチャートを 示す。移動ユニット16ほそれがスタンバイモード60 あるいは呼処理モード62(図4を参照)のいずれかで 動作している間に手順66を規則的なスケジュールで繰 り返し実行する。好ましい実施例においては、この規則 30 -的なスケジュールは数秒ごとに1度から数分または数時 間ごとに1度に変化し得る。

【0024】手順66の間においては、移動ユニット1 6は問い合わせタスク68を実行して側位システム24 (図1を参照)からの信号がその位置を決定する上で使 用するために利用できるか否かを判定する。通常の動作 においては、システム24は利用可能でありかつ位置を 決定するための好ましい技術である。従って、システム 24が利用可能である場合には、移動ユニット16は位 を実行しシステム2.4からの信号を受信する。タスク7 ()はその信号を伝統的な様式で処理して現在位置を示す 1組のバラメータを得る。

【0025】とれに対し、ネットワーク10がシステム 24に完全に依存することを防止するため、本発明は現 在位置を決定するためのバックアップ技術を含む。従っ で、システム24が利用できない場合には、タスク72 が実行されてネットワーク10の衡星12によって送信 される信号から現在位置を決定する。好ましい実施例に おいては、衛星12は地球に関しそれらの軌道を約2

5、000km/時で運行する。従って、これらの衛星 の信号はかなりの置のドップラ(Doppleェ)シフ トを受け、このドップラシフトは衛星が頭上を通る時に 変化する。さらに、衛星12はセルの位置データを送信 する。その結果、タスク72は、セルの位置データと組 み合わされた時、移動ユニット16の位置に対応するド ップラ記号(Doppler signature)を 得るために範囲(fange)および範囲レート(fa nge rate) データを監視する。タスク? 2にお る。この登録は識別データをサービスしているゲートウ「10」いて意図されているバックアップ技術はタスク?0の位 置決定技術よりも低速でありかつ精度が低いかも知れな い。それにもかかわらず、そのようなバックアップ位置 データは何らの位置データもないよりは好ましい。

> 【0026】移動ユニット16の現在位置がタスク70 または72のいずれかにおいて決定された後、タスク7 4 はその現在位置データをセーブしかつその現在位置を その移動ユニット16に対して確立された現在の境界線 22a-22b (図1を参照) に関して評価する。図5 に戻ると、位置テーブル54は、それぞれ、現在位置デ ータエレメント?6 および??を含む。

【0027】タスク70が現在位置を決定するために使 用された場合には、現在位置データは好ましくは緯度お よび経度を示す。ここで用いわれているように、用語 「緯度(!atitude)」および「経度(long tude)」は位置を識別することができる任意の他 の基準または測定技術を含むものと考えている。本発明 の上つの実施例においては、境界線データは最小および 最大の緯度および経度を示している。従って、境界線2 2は四角形または長方形であるのが都合が良い。タスク 74は現在位置を境界線22と比較して現在位置が境界 線22の外側にあるか否かを判定する。

【0028】本発明の別の実施例においては、境界線デ 一夕は半径(radius)と解釈される距離を示す。 位置チーブル54(図5を参照)のデータエレメント? 9は元の位置の緯度および経度を示している。タスク7 4はその現在位置を比較して移動ユニット16がこの半 径によって示されるものよりも元の位置から大きな距離 にあるか否かを調べる。この実施例では、境界線22 置決定受信機28(図2を参照)を利用してタスク70m40mは、図1に示されるように、元の位置に中心を有しかつ 境界線データによって規定される半径を有する四を形成 する。タスク?4は再び移動ユニット16が織界線22 の外側にあるか否かを判定する。当業者は境界線データ は四角形、長方形、または円を示すものに限定されず、 政策的な管轄区18の形状を含む任意の形状を示すよう にすることができることを理解するであろう。

> 【0029】タスク74の後、聞い合わせタスク78は もし移動ユニット16の現在位置が境界線22の外側に あればプログラム制御をタスク79に導く。タスク79 50 は現在位置のデータメッセージ80をネットワーク10

に送信する。図?はメッセージ80のための好ましいフ ォーマットのブロック図を示す。特に、メッセージ80 はネットワーク10にそれが現在位置メッセージである。 ことを通知するためのヘッダ82、ネットワーク10 に、どの移動ユニット16がメッセージを送信している かを通知するための!D84、および移動ユニット16 の現在位置を緯度/経度または他のバラメータ形式で示 す現在位置データ86を含む。

【0030】図6に戻ると、手順66はタスク79の後 りを受信するまで待機する。図8は、メッセージ90の ための好ましいフォーマットのブロック図を示す。特 に、メッセージ90は移動ユニット16にネットワーク 10が前の現在位置メッセージ80(図7を参照)を受 信したことを通知するアクノレッジメントプロック92 を含む。さらに、メッセージ90は境界線22(図1を 参照)を示す境界線データ94を含む。境界線データ9 4は結果として得られる境界線22がメッセージ80の 現在位置データ86(図?を参照)によって特定される 現在位置を囲むように構成されるべきである。

【0031】メッセージ90が受信された後、タスク9 6 (図6を参照) は境界線データ94 (図8を参照) を 位置テーブル54のデータエレメント77(図5を参 願)にセーブする。さらに、タスク96は位置テーブル 94の時間スタンプデータエレメント98を更新して現 在の日時を表示し、かつ位置テーブル54の元の位置デ ータエレメント?9(図5を参照)を更新して現在位置 を表示する。タスク96の後、プログラム制御は手順6 6を退出する。手順6.6はその後そのスケジュールに従 って繰り返される。

【0032】タスク78に戻ると、移動ユニット16の 現在位置が境界線22の外側にない場合には異なる処理 結果が生ずる。特に、手順66はネットワーク10への。 現在位置メッセージの送信をトリガすることができる他 の条件を調べる。一般に、これらの他の条件は通常の動 作においては滅多にしか生じないバックアップ条件であ る。従って、これらの条件の結果として発生する位置の 報告を取り扱う上で非常に少量の通信資源が消費される のみである。

100は移動ユニット16の現在位置が、データエレメ ント79(図5を参願)により示されるように、元の位 置から所定の距離だけ超えたか否かを判定する。好まし くは、この所定の距離は、移動ユニット16が境界線2 2を規定する上で何らかの問題に遭遇しない限りそれを「 超えることはありそうにないほどの大きな値にセットさ れる。もしこの所定の距離を超えると、タスク79、8 8および96が行われてネットワーク10を更新しかつ 境界線22に対する新しい規定を受信する。

【0034】もしこの所定の距離が超えられなければ、「50」できる。メッセージ80が受信された時、タスク110

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タスク102はデータエレメント98に記録された時間 スタンプ(図5を参照)を現在の日時と比較して所定の 期間が経過したか否かを判定する。好ましくは、この期 間は、1月に1度のような、非常に大きな値にセットさ れ、それにより比較的静止状態にある移動ユニット16 がそれらの位置をネットワーク10に報告する上でかな りの量の通信資源を消費しないようにされる。もしこの 所定の期間が超過しておらなければ、タスク104はブ ログラム制御を手順6.6を退出するようにさせる。これ にタスク88がネットワーク10から応答メッセージ9 10 に対し、もしこの所定の期間が経過しておれば、タスク 104はネットワーク10を更新するためにプログラム 制御をタスク79、88および96に導く。

> 【0035】タスク52(図4を参照)に戻ると、位置 テーブル54(図5を参照)の初期化は時間スタンプデ ータエレメント98を遠い過去の日を表す所定の値にセ ットすることができる。従って、付勢後に手順6.6が行 われて最初に、タスク104は大きな期間を検出し、現 在位置メッセージがネットワーク10に送信され、元の 位置および時間スタンプが更新され、かつ新しい境界線 20 データがネットワーク10から受信されるであろう。

【0036】手順66は好ましくは規則的なスケジュー ルで繰り返されるが、移動ユニット16は、ノード10 6に示されるように、ネットワーク10から現在位置命 令メッセージを任意の時間に受信することができる。現 在位置命令メッセージは移動ユニット16に対しその位 置を示すデータを送信することにより応答するよう指令 する。この命令が受信されると、手順66がアクティブ であろうとなかろうとタスク79、88および96が行 われる。上に述べたように、タスク79、88および9 30 6においては、移動ユニット16は現在位置メッセージ を送信しかつそれに応じて境界線データを期待する。 【0037】ゲートウェイ14は鰹ましくはネットワー ク10のための追跡機能を行なうが、この追跡機能はネ ットワーク10の他の箇所で行なうこともできる。各が ートウェイ14はそこに登録された移動ユニット16に 対しての機能を行なう。好ましい実施例においては、各 移動ユニット16はボーム(home)ゲートウェイ! 4を有するが、任意の他のゲートウェイ14によってサ ービスされる領域内に移動することができる。サービス 【0033】特に、好ましい実施顔では聞い合わタスクー40 しているゲートウェイ14およびホームゲートウェイ1 4は互いにネットワーク10またはPSTNを通して加 入者移動ユニット16に関する情報を共有するために必 要に応じて互いに通信することができる。図9はサービ スしているゲートウェイ14によってそれらの登録され た移動ユニット16のために位置データを維持する上で |行なわれる手順のプローチャートを示す。ゲートウェイ 14から見ると、現在位置メッセージ80(図7を参 願) は、ノード108に示されるように、任意の登録さ れた移動ユニット16から任意の時間に受信することが

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はメッセージ80から現在位置データ86(図7を参 麗) を得る。

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【0038】タスク112は現在位置データ86をメモ リ46(図3を参照)内に維持された加入者データベー ス114のメモリ構造の中にセーブする。図10はデー タベース114のブロック図を示す。データベース11 4は善々の登録された移動ユニット16に対する記録1 16を含む。蓋々の記録116は移動ユニットのIDに 対するデータフィールド118、移動ユニットの電話番 の位置に対するデータフィールド122、前記元の位置 に関連する時間スタンプのためのデータフィールド12 4. および他のデータエレメント126を含む。他のデ ータエレメント126は関係するホームまたはサービス 中のゲートウェイ、課金命令、サービスレベル識別子、 およびネットワーク10の動作にとって必要な任意の他 のデータを示す。

【0039】図9~図10を参照すると、元の位置のデ ータフィールド122は関連する移動ユニット16の最 れるのはデータフィールド122である。言い換えれ は、その現在位置が今や元の位置として使用される。タ スク128は時間スタンプデータフィールド124に現 在の日時をセーブする。

【0040】次に、タスク130は境界線データを発生 するために移動ユニット16から受信したばかりの現在 の/元の位置を使用する。好ましい実施例においては、 タスク130は境界線データベース132を使用して該 織界線データを発生する。図11はメモリ46(図3を リ構造のブロック図を示す。境界線データベース132 はゲートウェイ14によってサービスを受ける領域のセ クションを示す記録134を含む。善セクションは最小! |緯度136、最大緯度138、最小経度140、および| 最大経度142によって特徴づけられる。データベース 132はゲートウェイ14によってサービスを受ける鎖 域を表現するのに必要なだけ多くの記録134を含む。 この領域は、必ずしもそうである必要はないが、1つま たはそれ以上の管轄区18(図1を参照)に適合させる。 む。境界線データ144は関連する緯度および経度13 $6 \sim 1.42$ によって規定されるセクション内に位置する 任意の移動ユニット16に関連されるべき境界線22 (図1を参照)を記述する。上に述べたように、境界線 データ144は半径として作用する距離を表すことがで きる。或いは、境界線データ144は緯度および経度を 表すことができる。実際上、緯度および経度136~1 42は境界線データ144として働くことができる。 【0041】図9および図11を参照すると、タスク1

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ータによって示される記録134をデータベース132 内に検出するためにテーブルルックアップ動作を行な う。好ましい実施例においては、タスク130はデータ ベース132のデータエレメント144から適切な機界 | 線データを単に読むだけである。この境界線データは前 記位置データによって示される位置を囲む機界線22を 規定するよう構成される。もし前記位置データが、例え ば、ドップラバラメータおよび衛星バラメータの型式に なっておけば、タスク130はデータベース132に対 号に対するデータフィールド120、移動ユニットの元(10)してテーブルルックアップを行なう前にそのようなパラ メータを緯度および経度データに変換する。

> 【0042】タスク130が境界線データを得た後、タ スク146は境界線データ応答メッセージ90(図8を 参照)を移動ユニット16に返送する。タスク146の 後、ゲートウェイ14およびネットワーク10はノード 108において受信された現在位置メッセージの処理を 終了している。

【0043】ゲートウェイ14はさらにその元の位置が、 できるだけ現在位置に近いことを保証するためにメンテ 後に知られた位置を示す。現在位置データ86が格納さ「20」 ナンス手順148を行なうことができる。タスク150 に示されるように、手順148は好ましくはビークをは ずれた(off-peak)トラフィック時間にのみ行 なわれる。言い換えれば、もしゲートウェイ14を介し たネットワーク10における通信トラフィックがそのビ ーク容量に近くなっておれば、手順148は後に延期さ れる。このようにして、手順148を実行することから 生ずる通信が加入者が必要とするかもしれない通信資源 を奪うことがなくなる。

【0044】タスク152において、加入者データベー 麥照)内に維持される境界線データベース132のメモ 30 ス114(図10を麥照)における記録116の時間ス タンプ124がサーチされて古くなった元の位置データ を育する現在登録されている加入者を探す。タスク15 2はその時間スタンプ124が現在時間に関して少なく とも所定の年齢を示すいずれかの記録116をサーチす ることができる。古い記録がみつけられると、タスク1 5.4 は現在位置命令を示された移動ユニット1.6 に送信 しかつ該移動ユニット16から応答を待つ。応答が受信 されると、タスク110、112、128、130およ び146が上に述べたように実行されて元の位置および。 ことができる。菩記録134は境界線データ144を含 40 時間スタンプデータエレメント122および124を更 新しかつ移動ユニット16に新しい境界線データを戻 す。タスク146を行なった後、メンテナンス手順14 8は他の古い加入者記録116に関して繰り返すことが できる。

[0045]

【発明の効果】以上要するに、本発明は有効な位置デー タを維持するために必要な通信の置を最少化する追跡シ ステムを提供する。移動ユニットは境界線データによっ て動的にプログラムされ、かつ該境界線データは移動ユ 30は移動ユニット16から受信されたばかりの位置デー50 ニットの位置に個々に適応される。従って、本発明はそ

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の中で移動ユニットが動作できる種々の領域によって課 される種々の位置報告の必要性に対応できる。

【0046】以上のように本発明が好ましい実施例に関 して説明された。しかしながら、当業者は本発明の範囲 から離れることなくこの好ましい実施例において変更お よび修正をなすことができることを認識するであろう。 例えば、好ましい実施例は移動ユニット16に対し位置 信号を提供するためのGPS衛星ベース測位システムを 使用することに関して説明されているが、他の測位シス テムまたは方法も使用できる。ことで用いられているよ 10 タベースメモリ構造を示すブロック図である。 うに、周語「位置決定(position locat ! o n) 」は、衛星ベースであれあるいは地上ベースで あれ、当業者に可能な他の位置決定手段および方法を含 むものと考えている。LORANはすでに世界の多くの 部分で利用可能な地上をベースとした測位システムの一 例である。他の側位手段および方法も知られている。従 って、当業者に明らかなこれらおよび他の変更および修 正は本発明の範囲内に含まれるものと考える。

【図面の簡単な説明】

【図1】その中で通信ネットワークが動作する地球の鎖 20 24 衛星測位システム 域を示す説明図である。

【図2】前記ネットワークと通信する移動ユニットを示 すブロック図である。

【図3】前記ネットワークにおいてノードとして作用す るゲートウェイを示すプロック図である。

【図4】前記移動ユニットによって行なわれるパワーア ップ手順を示すフローチャートである。

【図5】前記移動ユニット内に維縛される位置テーブル メモリ構造を示すブロック図である。

*【図6】前記移動ユニットによって行なわれる測位手順 を示すフローチャートである。

【図7】前記移動ユニットによって送信される現在位置 データメッセージを示すブロック図である。

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【図8】前記ゲートウェイによって送信される境界線デ ータメッセージを示すプロック図である。

【図9】前記ゲートウェイによって行なわれる手順を示 **すフローチャートである。**

【図10】前記ゲートウェイ内に維持される加入者デー

【図11】前記ゲートウェイ内に維持される境界線デー タベースメモリ構造を示すプロック図である。

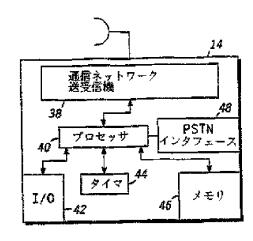
【符号の説明】

- 10 通信ネットワーク
- 12 人工衛星
- 14 ゲートウェイ
- 16 移動ユニット
- 18 政策的管轄区
- 20、22 境界線
- - 2.6 送受信機
 - 28 受信機
 - 30 プロセッサ
 - 32、42 入力/出力(1/0) セクション

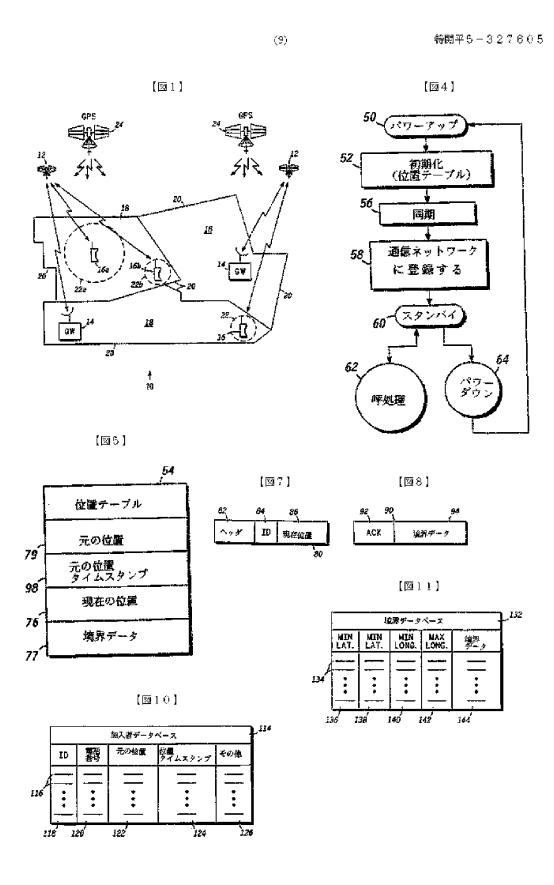
[23]

- 34, 44 タイマ
- 38 送受信機
- 40 プロセッサ
- 48 PSTNインタフェース

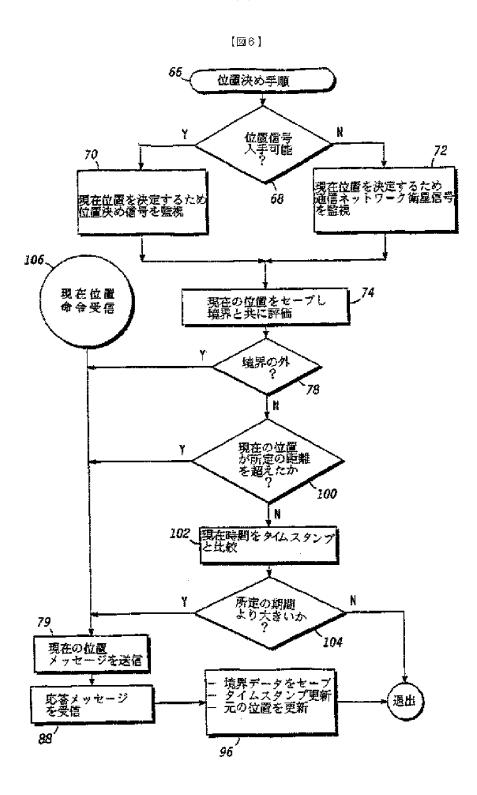
[图2] 28 26 通信 位置決定 ネットワーク 送受信機 受信機 30 プロセッサ 36 32 タイマ メモリ 1/0 34 16



(8)



(10) 特關平5-327605



特開平5-327605 **(11)** [29] 148 メンテナンス ピーク トラフィック でないか ? Ν 退出 150 152 古い記録を加入者 データベースでサーチ 108 154 現在位置命令を 送信、応答を待つ 現在位置 メッセージ を受信 110 メッセージから 現在位置を得る 112 現在位置を元の位置 としてセーブ 128 時間スタンプセーブ 130 境界データ発生 146 境界データ応答 メッセージ送属 退出

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